APPENDIX A
Explanatory Material

SAMPLE DESIGN AND ESTIMATION PROCEDURES

New samples were introduced with the 1999 Annual Wholesale Trade Survey (AWTS) and with the March 2001 Monthly Wholesale Trade Survey (MWTS). The new samples were designed to produce estimates based on the North American Industry Classification System (NAICS) and replace samples designed to produce estimates based on the Standard Industrial Classification (SIC) system. This section describes the design, selection, and estimation procedures for the new samples. For descriptions of the prior samples see the *Annual Benchmark Report for Wholesale Trade for January 1990 to February 2000* or prior benchmark reports.

Sampling Frame

The same sampling frame was used for the Monthly Wholesale Trade Survey (MWTS) and the Annual Wholesale Trade Survey (AWTS). The sampling frame has two types of sampling units represented -- Employer Identification Numbers (EINs) and large, multiple-establishment firms. Both sampling units represent clusters of one or more establishments owned or controlled by the same firm. The information used to create these sampling units was extracted from data collected as part of the 1997 Economic Census and from establishment records contained on the Census Bureau's Business Register as updated to June 1999. The next few paragraphs give details about the Business Register; the distinction between firms, EINs, and establishments; and the construction of the sampling units. Though important, they are not essential to understanding the basic sample design and readers may continue to the **Stratification, Sampling Rates, and Allocation** section.

The Business Register is a multi-relational database that contains a record for each known establishment that is located in the United States or one of its territories and has employees. An *establishment* is a single physical location where business transactions take place and for which payroll and employment records are kept. Groups of one or more establishments under common ownership or control are *firms*. A *singleunit* firm owns or operates only one establishment. A *multiunit* firm owns or operates two or more establishments. The treatment of establishments on the Business Register differs according to whether the establishment is part of a *singleunit* or *multiunit* firm. In particular, the structure of an establishment's primary identifier on the Business Register differs depending on whether it is owned by a *singleunit* firm or by a *multiunit* firm.

A *singleunit* firm's primary identifier is its Employer Identification Number (EIN). The Internal Revenue Service (IRS) issues the EIN and the firm uses it as an identifier to report social security payments for its employees under the Federal Insurance Contributions Act (FICA). The same act requires all employer firms to use EINs. Each employer firm is associated with at least one EIN and only one firm can use a given EIN. Because a *singleunit* firm has only one establishment, there is a one-to-one relationship between the firm and the EIN. Thus the firm, the EIN, and the establishment all reference the same physical location and all three terms can be used interchangeably and unambiguously when referring to a *singleunit* firm.

For *multiunit* firms however, a different structure connects the firm with its establishments via the EIN. Essentially a *multiunit* firm is associated with a cluster of one or more EINs and EINs are associated with one or more establishments. A *multiunit* firm consists of at least two establishments. Each firm is associated with at least one EIN and only one firm can use a given EIN. However, one *multiunit* firm may have several EINs. Similarly, there is a one-to-many relationship between EINs and establishments. Each EIN can be associated with many establishments but each establishment is associated with only one EIN. Because of the possibility of one-to-many relationships, we must distinguish between the firm, its EINs, and its establishments. The *multiunit* firm that owns or controls a particular establishment is identified on the Business Register by way of the establishment's primary identifier.

The primary identifier of an establishment owned by a *multiunit* firm consists of a unique combination of an alpha number and a plant number. The alpha number identifies the *multiunit* firm, and the plant number identifies a particular establishment within that firm. All establishments owned or controlled by the same *multiunit* firm have the same alpha number. Different *multiunit* firms have different alpha numbers, and different establishments within the same *multiunit* firm have different plant numbers. The Census Bureau assigns both the alpha number to the *multiunit* firm and plant numbers to the corresponding establishments based on the results of the quinquennial economic census and the annual Company Organization Survey.

To create the sampling frame, we extract the records for all establishments classified as merchants within the Wholesale Trade sector as defined by the 1997 North American Industry Classification System. For these establishments, we extract sales, payroll, employment, inventory, name and address information, as well as primary identifiers and, for establishments owned by *multiunit* firms, associated EINs. To create the sampling units for *multiunit* firms, we aggregate the economic data of the establishments owned by these firms to an EIN level by tabulating the establishment data for all extracted establishment records (i.e., establishments classified in the Wholesale Trade sector) associated with the same EIN. Similarly we aggregate the data to a *multiunit* firm level by tabulating the establishment data for all extracted establishment records associated with the same alpha number. No aggregation is necessary to put *singleunit* establishment information on an EIN basis or a firm basis. Thus, the sampling units created for *singleunit* firms simultaneously represent establishment, EIN, and firm information. In summary, the sampling frame is a complex amalgam of establishments, EINs, and firms.

Stratification, Sampling Rates, and Allocation

The primary stratification of the frame is by kind-of-business group based on the detail required for this publication. We further stratify the sampling units within kind-of-business group (substratify) by a measure of size related to their annual sales. Sampling units expected to have a large effect on the precision of the estimates are selected "with certainty." This means they have a 100% chance of selection and will represent only themselves (i.e., have a selection probability of one and a sampling weight of one). Within each kind-of-business stratum we determined a substratum boundary that divides the certainty units from the noncertainty units. We based these cutoffs on a statistical analysis of data from the 1997 Economic Census. Accordingly, these

values are on a 1997 sales basis. We also used this analysis to identify companies with large 1997 inventory as certainty units, to determine the number of size substrata for each kind-of-business stratum, and to set preliminary sampling rates needed to achieve specified sampling variability objectives on sales (or inventory) estimates for different kind-of-business groups. The size substrata and sampling rates were later updated through an analysis of the sampling frame.

Sample Selection

The first step in the sample selection identified certainty firms. If a firm was selected with certainty and had more than one establishment at the time of sampling, any new establishments that the firm acquires, even if under new or different EINs, are included in the sample with certainty. However, if a *singleunit* firm was selected with certainty, only future establishments associated with that firm's originally-selected EIN are included in the sample with certainty; any new EINs that might later be associated with that firm are subjected to sampling through the quarterly birth-selection procedure (see **Sample Maintenance**).

All firms not selected with certainty were subjected to sampling on an EIN basis. If a firm had more than one EIN, we treated each of its EINs as a separate sampling unit. To be eligible for the initial sampling, an EIN used by a *singleunit* firm had to have nonzero payroll in 1998. EINs used by *multiunit* firms were required to have nonzero payroll in 1997. The EINs were stratified according to their major kind of business and their estimated annual sales (on a 1997 basis). Within each noncertainty stratum, a simple random sample of EINs was selected. We then assigned the selected noncertainty EINs to one of two groups. One group is canvassed for both the monthly and annual surveys, the other only for the annual survey. The maximum sampling weight for an EIN selected for the monthly survey was 800. The maximum sampling weight for an EIN selected for the annual survey was 400.

Sample Maintenance

Periodically, we update the samples to represent EINs issued since the initial sample selection. These new EINs, called births, are EINs recently assigned by the IRS, on the latest available IRS mailing list for FICA taxpayers, and assigned a kind-of-business classification (if possible) by the Social Security Administration (SSA).

EIN births are sampled on a quarterly basis using a two-phase selection procedure. To be eligible for selection, a birth must either have no kind-of-business classification or be classified in a kind of business within the scope of AWTS, the Annual Retail Trade Survey (ARTS), or the Service Annual Survey (SAS), and it must meet certain criteria regarding its number of paid employees or quarterly payroll. In the first phase, births are stratified by kind of business and a measure of size based on expected employment or quarterly payroll. A relatively large sample is drawn and canvassed to obtain a more reliable measure of size, consisting of sales in two recent months, and a new or more detailed kind-of-business classification.

Using this more reliable information, the selected births from the first phase are subjected to probability proportional-to-size sampling with overall probabilities equivalent to those used in drawing the initial AWTS, ARTS, and SAS samples from the June 1999 Business Register.

Because of the time it takes for a new employer firm to acquire an EIN from the IRS, and because of the time needed to accomplish the two-phase birth-selection procedure, births are added to the samples approximately nine months after they begin operation.

The processing of the EIN births differs between the monthly (MWTS) and annual (AWTS) surveys. For the MWTS, EIN births selected in a quarter are added into the survey during the next quarter. Because births are not represented in the monthly sample until they go through the two-phase selection procedure, an interim procedure is used to account for births during the period between the onset of activity and the time of birth selection. This consists of imputing data for all EINs selected in the monthly sample that go out of business but are still on the IRS mailing list.

For the AWTS, EIN births that are selected in the quarterly birth-selection procedure in November of the annual survey year are included in the initial mailing of the AWTS questionnaires in February of the following year. To better represent all EIN births in the annual survey year, and specifically to account for the time it takes to identify and select new EINs, we add births to the annual sample that are selected in February, May, and August of the year following the annual survey year. We mail survey forms to these births around June and August to supplement the initial annual survey mailing.

To be eligible for the sample canvass and tabulation, an EIN selected in the noncertainty sampling operations must meet both of the following requirements:

- It must be on the latest available IRS mailing list for FICA taxpayers from the previous quarter.

- It must have been selected from the Business Register in either the initial sampling or during the quarterly birth-selection procedure.

EINs selected into the samples with certainty are not dropped from canvass and tabulation if they are no longer on the IRS mailing list. Rather, the firm that used the EIN is contacted, and if a successor EIN is found, it is added to the survey.

Monthly Estimation Procedures

The estimates of monthly sales and end-of-month inventories published in this report are derived from data collected in the Monthly Wholesale Trade Survey (MWTS). Each month, all firms selected with certainty (sampling weight equal to 1) and one of the two groups of noncertainty (sampling weight greater than 1) EINs are asked to report their sales and inventory data for the month just ending. (As noted in the **Sample Selection** section, noncertainty EINs are assigned to one of two groups. One group is canvassed for the monthly and annual survey while the other group is canvassed only for the annual survey.) Estimates of monthly sales and end-of-month inventories are computed as the sum of weighted data (reported and imputed) for all selected sampling units that meet the tabulation criteria given in the **Sample Maintenance** section. The weight for a given sampling unit is the reciprocal of its probability of selection into the MWTS

sample. The monthly estimates are benchmarked using the corresponding annual survey estimates and economic census results. See the **Revisions to Previously Published Estimates** section located at the beginning of this report for a description of the benchmarking procedures.

Estimation Procedures for Annual Totals

Published estimates of annual sales, end-of-year inventories, and purchases for 2002 were computed by multiplying the revised 2001 annual estimates by the corresponding 2001-to-2002 change estimated from the 2001 and 2002 Annual Wholesale Trade Surveys. All firms selected with certainty and both groups of noncertainty EINs are asked to report data for the reference year. (Two years of data are requested in the year in which a new sample is introduced.) Estimates are computed as the sum of weighted data (reported and imputed) for all selected sampling units that meet the tabulation criteria given in the **Sample Maintenance** section. The weight for a given sampling unit is the reciprocal of its probability of selection into the AWTS sample. Because both groups of noncertainty EINs are canvassed for the annual survey, the annual estimates have less sampling variability than the corresponding monthly estimates. The annual estimates presented in this report have been adjusted using results of the 1997 Economic Census.

The estimates of total end-of-year inventory published in this report are on a non-LIFO basis. For those firms that reported inventory on a LIFO (last-in, first-out) basis, the LIFO reserve amount is **added** to the LIFO value to get inventory on a non-LIFO basis. In the annual survey, sampling units that used a LIFO cost basis for all or part of their inventory were asked to report LIFO reserves.

The estimates of gross margin represent sales minus the cost of goods sold (see **Definition of Terms** section) and are computed as a function of weighted sales, inventories, and purchases data from the AWTS.

RELIABILITY OF THE ESTIMATES

The total error of an estimate based on a sample survey is the difference between the estimate and the population parameter that it estimates. This error may be considered to be comprised of sampling error and nonsampling error. Sampling error is the difference between the estimate and the result that would be obtained from a complete enumeration of the sampling frame conducted under the same survey conditions. This error occurs because characteristics differ among sampling units and because only a subset of the entire population is measured in a sample survey. Nonsampling error encompasses all other factors that contribute to the total error of a sample survey estimate. The accuracy of a survey result may be affected by these two types of errors.

Sampling and nonsampling errors are often measured by the quantities, bias and variance. The *bias* of an estimator of a population parameter is the difference, averaged over all possible samples of the same size and design, between the estimator and the population parameter being estimated. (The population parameter is usually unknown.) Any systematic error, or inaccuracy

that affects all samples of a specified design in a similar way, may bias the resulting estimates. The *variance* of an estimator is the squared difference, averaged over all possible samples of the same size and design, between the estimator and its average value.

Descriptions of sampling and nonsampling errors for the Monthly Wholesale Trade Survey (MWTS) and the Annual Wholesale Trade Survey (AWTS) are provided in the following sections.

Sampling Error

Because the estimates are based on a sample, exact agreement with results that would be obtained from a complete enumeration of merchant wholesale firms on the sampling frame using the same enumeration procedures is not expected. However, because each firm represented on the sampling frame has a known probability of being selected into the sample, it is possible to estimate the sampling variability of the survey estimates.

The particular sample used in this survey is one of a large number of samples of the same size that could have been selected using the same design. If all possible samples had been surveyed under the same conditions, an estimate of a population parameter of interest could have been obtained from each sample. These samples give rise to a distribution of estimates for the population parameter. A statistical measure of the variability among these estimates is the standard error, which can be approximated from any one sample. The *standard error* is defined as the square root of the variance. The *coefficient of variation* (or relative standard error) of an estimator is the standard error of the estimator divided by the estimator. Note that measures of sampling variability, such as the standard error and coefficient of variation, are estimated from the sample and are also subject to sampling variability. (Technically, we should refer to the *estimated* standard error or the *estimated* coefficient of variation of an estimator. However, for the sake of brevity, we have omitted this detail.) It is important to note that the standard error and coefficient of variation only measure sampling variability. They do not measure any systematic biases in the estimates. Table 3 provides the minimum, maximum, and median coefficients of variation for estimates of monthly sales and end-of-month inventories for each kind of business. The ranges and medians shown in Table 3 are based on the latest available MWTS estimates for January 2003 through December 2003. Coefficients of variation for estimates of annual sales, end-of-year inventories, purchases, gross margin, and gross margin-to-sales ratios for each kind of business are provided in Table 4. These coefficients of variation are based on 2002 AWTS data, adjusted using results of the 1997 Economic Census. (All coefficients of variation are expressed as percents.) The Census Bureau recommends that individuals using estimates contained in this report incorporate this information into their analyses, as sampling error could affect the conclusions drawn from these estimates.

The estimate from a particular sample and the standard error associated with the estimate can be used to construct a confidence interval. A *confidence interval* is a range about a given estimator that has a specified probability of containing the result of a complete enumeration of the sampling frame conducted under the same survey conditions. Associated with each interval is a percentage of confidence, which is interpreted as follows. If, for each possible sample, an estimate of a population parameter and its approximate standard error were obtained, then:

1. For approximately 90 percent of the possible samples, the interval from 1.645 standard errors below to 1.645 standard errors above the estimate would include the result of a complete enumeration.

2. For approximately 95 percent of the possible samples, the interval from 1.96 standard errors below to 1.96 standard errors above the estimate would include the result of a complete enumeration.

To illustrate the computation of a confidence interval for an estimate of total sales, assume that an estimate of total sales is $10,750 million and the coefficient of variation for this estimate is 1.8 percent, or 0.018. First obtain the standard error of the estimate by multiplying the total sales estimate by its coefficient of variation. For this example, multiply $10,750 million by 0.018. This yields a standard error of $193.5 million. The upper and lower bounds of the 90-percent confidence interval are computed as $10,750 million plus or minus 1.645 times $193.5 million. Consequently, the 90-percent confidence interval is $10,432 million to $11,068 million. If corresponding confidence intervals were constructed for all possible samples of the same size and design, approximately 9 out of 10 (90 percent) of these intervals would contain the result obtained from a complete enumeration.

Nonsampling Errors

Nonsampling error encompasses all other factors that contribute to the total error of a sample survey estimate and may also occur in censuses. It is often helpful to think of nonsampling error as arising from deficiencies or mistakes in the survey process. In the MWTS and the AWTS, nonsampling error can be attributed to many sources: inability to obtain information about all units in the sample; response errors; differences in the interpretation of the questions; mistakes in coding or keying the data obtained; and other errors of collection, response, coverage, and processing. Additional nonsampling error may have been introduced by the method used to adjust the survey estimates using results of the 1997 Economic Census. Although no direct measurement of the potential biases due to nonsampling error has been obtained, precautionary steps were taken in all phases of the collection, processing, and tabulation of the data in an effort to minimize their influence. The Census Bureau recommends that individuals using estimates in this report incorporate this information into their analyses, as nonsampling error could affect the conclusions drawn from these estimates.

A potential source of bias in the estimates is nonresponse. Nonresponse is defined as the inability to obtain all the intended measurements or responses about all selected units. Two types of nonresponse are often distinguished. *Unit nonresponse* is used to describe the inability to obtain any of the substantive measurements about a sampled unit. In most cases of unit nonresponse, the questionnaire was never returned to the Census Bureau, after several attempts to elicit a response. *Item nonresponse* occurs either when a question is unanswered or the response to the question fails computer or analyst edits.

For both unit and item nonresponse, a missing value is replaced by a predicted value obtained from an appropriate model for nonresponse. This procedure is called *imputation* and uses survey

data and administrative records as input. In any given month, imputed data amounts to about 30 percent of the total monthly wholesale sales estimate and about 32 percent of the total wholesale end-of-month inventory estimate. For the annual survey, imputed data amounts to about 10 percent of the total wholesale sales estimate, about 13 percent of the total wholesale end-of-year inventory estimate, and nearly 15 percent of the total purchases estimate.

ADJUSTMENT FOR SEASONAL AND TRADING-DAY VARIATION

We use the X-12 ARIMA Program to derive the factors for adjusting data for seasonal variations and, in the case of sales, for trading day differences. Seasonal adjustment of estimates is an approximation based on current and past experiences. Therefore, the adjustment could become less precise because of changes in economic conditions and other elements that introduce significant changes in seasonal and trading-day patterns.

Concurrent seasonal adjustment uses all available unadjusted estimates (including the latest *preliminary* estimates) as input to the X-12 ARIMA program. When unadjusted *preliminary* and final estimates become available, all estimates are used as input to the X-12 ARIMA program and new factors are applied to the *preliminary* and final estimates (1 month before the *preliminary*) and to the previous year estimates that correspond to the *preliminary* month.

SCOPE OF SURVEY

Wholesale trade, as defined by sector 42 of the 1997 North American Industry Classification System manual, as covered in the 1997 Census of Wholesale Trade and 1999 Annual Trade Survey (AWTS), includes establishments organized to sell or arrange the purchase or sale of a) goods to other wholesalers or retailers, b) capital or durable non-consumer goods, and c) raw and intermediate materials and supplies used in production.

- Wholesalers sell merchandise to other businesses and normally operate from a warehouse or office with a design and location that is not intended to solicit walk-in traffic and with little or no display of merchandise.

- Customers are generally reached initially via telephone, in-person marketing or by specialized advertising.

- Follow-up orders are either vendor-initiated or client-initiated generally based on previous sales, and typically exhibit strong ties between sellers and buyers.

The two principal types of establishments included in wholesale trade are:

a) Merchant wholesalers who take title to the goods they sell such as wholesale merchants or jobbers, drop shippers, import/export merchants and sales branches.
b) Agents, merchandise or commodity brokers, commission merchants, import/export agents and brokers, auction companies and manufacturers representatives.

DEFINITION OF TERMS

Sales.   Sales include:

      1. Merchandise sold for cash or credit at wholesale and retail by
         establishments primarily engaged in merchant wholesale trade;

      2. Receipts from customers for rental or leasing of equipment,
         instruments, tools, etc.;

      3. Receipts for delivery, installation, alteration, maintenance, repair,
         storage, and other services; and

      4. Gasoline, liquor, tobacco, and other excise taxes which are paid by the
         manufacturer and passed along to the wholesaler.

Sales are net after deductions for refunds and allowances for merchandise returned by customers. Sales that are made on an agency basis for others are included as gross sales. Direct shipments on orders from wholesalers are also included in sales. Total sales do not include non-operating income from such sources as investments, rental or sale of real estate, etc.

Sales exclude sales taxes and excise taxes collected directly from customers and paid directly to a local, State, or Federal tax agency. Also excluded are receipts from customers for carrying or other credit charges.

Inventories. Inventories represent stocks on a non-LIFO basis (firms that valued inventory on a LIFO basis included the values of LIFO reserve in the total inventory levels) of merchandise owned by merchant wholesalers at the end of the month, regardless of location, except for goods held outside the United States. Goods held on consignment and items not held for sale such as fixtures, equipment, and supplies are not included. Goods held in foreign trade zones in the United States are also included. Methods of valuation may vary according to the accounting practices of the firm.

Inventories/Sales Ratios. The inventories/sales ratios are derived by dividing the dollar value of inventories by the dollar value of sales. No adjustment is made in these ratios for the markup in sales which may vary from trade to trade.

Purchases. Purchases represent the total cost of merchandise acquired for resale during the year, whether or not payment for the merchandise was made during the year. Purchases are net of returns, allowances, and trade and cash discounts but include payments by the wholesaler for freight, insurance, import duties, and credit and other charges. Purchases exclude the cost of containers, wrapping, packaging, and selling supplies. Also excluded are liquor and tobacco tax stamps.

Cost of Goods Sold. Cost of goods sold are not shown in this report but can be derived by subtracting gross margin data from annual sales data. They represent the total cost of

merchandise sold for cash or credit at wholesale and retail by establishments primarily engaged in merchant wholesale trade. Cost of goods sold is calculated by adding all purchases of merchandise (net of returns, allowances, and discounts but including charges for freight, insurance, etc.) during the year to the beginning year inventories, then deducting the end-of-year inventories from the total. Firms were instructed to exclude the cost of containers, wrapping, packaging, and selling supplies in the cost of purchases. Purchase of tax stamps and payments of excise taxes often included by tobacco and liquor wholesalers in their purchases were excluded from cost of goods sold.

Gross Margin. Gross margin represents sales less cost of goods sold. Gross margin is equivalent to the cost of all materials (as distinguished from goods to be resold) and services provided in merchant wholesale establishments, whether provided by the merchant wholesaling firm itself or purchased by it from others. To the extent that it includes cost of contract work done by others on materials of the merchant wholesale firms, gross margin includes an element of value added by manufacturing.

Gross Margins as A Percent of Sales. Gross margins as a percent of sales is derived by dividing the gross margin by dollar value of sales. No adjustments are made for service revenues that may be included in sales data.

CLASSIFICATION DIFFERENCES BETWEEN THE MONTHLY SURVEY AND THE 1997 CENSUS OF WHOLESALE TRADE

Establishments in the census that are classified in the Farm Product Raw Materials group (NAICS code 4225) include, in their sales, products purchased and transferred to other company establishments. In the monthly survey, intercompany transfers are not included in sales. Because of these differences, we use estimates from the Annual Trade Survey (AWTS) .

Inventories were not benchmarked to the census inventory levels, because the census of wholesale trade does not include inventories of auxiliary and central administrative offices of merchant wholesale establishments. These offices, however, are included in the monthly and annual survey inventory estimates.